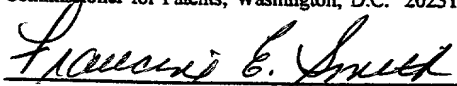




FORM PTO-1390 (REV 10-2000)		U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE		ATTORNEY'S DOCKET NUMBER 01597/LH	
TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371					
INTERNATIONAL APPLICATION NO. PCT/SE00/00591		INTERNATIONAL FILING DATE 27 March 2000		PUBLICATION NO. (if known, see 37 CFR 1.5) 09/937802	
PRIORITY DATE CLAIMED 26 March 1999					
TITLE OF INVENTION "ROTOR FOR A HIGH SPEED PERMANENT MAGNET MOTOR"					
APPLICANT(S) FOR DO/EO/US Thord Agne NILSON					
<p>Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:</p> <ol style="list-style-type: none"> 1. <input checked="" type="checkbox"/> This is a FIRST submission of items concerning a filing under 35 U.S.C. 371. 2. <input type="checkbox"/> This is a SECOND or SUBSEQUENT submission of items concerning a filing under 35 U.S.C. 371. 3. <input type="checkbox"/> This is an express request to promptly begin national examination procedures (35 U.S.C. 371(f)). 4. <input checked="" type="checkbox"/> The US has been elected by the expiration of 19 months from the priority date (PCT Article 31). 5. <input checked="" type="checkbox"/> A copy of the International Application as filed (35 U.S.C. 371(c)(2)) <ol style="list-style-type: none"> a. <input type="checkbox"/> is attached hereto (required only if not communicated by the International Bureau). b. <input checked="" type="checkbox"/> has been communicated by the International Bureau. c. <input type="checkbox"/> is not required, as the application was filed in the United States Receiving Office (RO/US). 6. <input type="checkbox"/> An English language translation of the International Application as filed (35 U.S.C. 371(c)(2)). 7. <input type="checkbox"/> Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3)) <ol style="list-style-type: none"> a. <input type="checkbox"/> are attached hereto (required only if not communicated by the International Bureau). b. <input type="checkbox"/> have been communicated by the International Bureau. c. <input type="checkbox"/> have not been made; however, the time limit for making such amendments has NOT expired. d. <input type="checkbox"/> have not been made and will not be made. 8. <input type="checkbox"/> An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)). 9. <input type="checkbox"/> An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)). 10. <input type="checkbox"/> An English language translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)). <p>Items 11 to 16 below concern document(s) or information included:</p> <ol style="list-style-type: none"> 11. <input checked="" type="checkbox"/> An Information Disclosure Statement under 37 CFR 1.97 and 1.98. 12. <input type="checkbox"/> An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included. 13. <input type="checkbox"/> A FIRST preliminary amendment. <input type="checkbox"/> A SECOND or SUBSEQUENT preliminary amendment. 14. <input type="checkbox"/> A substitute specification. 15. <input type="checkbox"/> A change of power of attorney and/or address letter. 16. <input checked="" type="checkbox"/> Other items or information: copy of <ol style="list-style-type: none"> (i) WO 00/59097, the 18-month publication of PCT/SE00/00591 (ii) Certificate of Registration showing the change of name from Atlas Copco Controls Aktiebolag to Immotion Technologies Aktiebolag 					
ASSIGNMENT INFORMATION FOR PUBLICATION: IMMOTION TECHNOLOGIES AKTIEBOLAG Stockholm, Sweden			Express Mail Mailing Label No.: EL 797 383 874 US Date of Deposit: September 26, 2001 I hereby certify that this paper and any papers identified herein is being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 CFR 1.10 on the date indicated above and is addressed to the Assistant Commissioner for Patents, Washington, D.C. 20231  Francine E. Smith		

09/937802

U.S. APPLICANT PCT/SE00/00591		INTERNATIONAL APPLICATION NO.		ATTORNEY'S DOCKET NUMBER 01597/LH	
17. <input checked="" type="checkbox"/> The following fees are submitted: BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) - (5)): Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO \$1000.00 International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO \$860.00 International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO \$710.00 International preliminary examination fee paid to USPTO (37 CFR 1.482) but all claims did not satisfy provisions of PCT Article 33(1)-(4) \$690.00 International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(1)-(4) \$100.00 ENTER APPROPRIATE BASIC FEE AMOUNT =				CALCULATIONS PTO USE ONLY 	
Surcharge of \$130.00 for furnishing the oath or declaration later than <input type="checkbox"/> 20 <input type="checkbox"/> 30 months from the earliest claimed priority date (37 CFR 1.492(e)).				\$	
CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE		
Total claims	9 - 20 =	0	X \$18.00	\$ -	
Independent claims	1 - 3 =	0	X \$80.00	\$ -	
MULTIPLE DEPENDENT CLAIM(S) (if applicable)			+ \$270.00	\$ 270.00	
TOTAL OF ABOVE CALCULATIONS =				\$1,270.00	
<input type="checkbox"/> Applicant claims small entity status. See 37 CFR 1.27. The fees indicated above are reduced by 1/2.				\$	
SUBTOTAL =				\$1,270.00	
Processing fee of \$130.00 for furnishing the English translation later than <input type="checkbox"/> 20 <input type="checkbox"/> 30 months from the earliest claimed priority date (37 CFR 1.492(f)).				\$	
TOTAL NATIONAL FEE =				\$1,270.00	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). \$40.00 per property +				\$	
TOTAL FEES ENCLOSED =				\$1,270.00	
				Amount to be refunded:	\$
				charged:	\$
a. <input checked="" type="checkbox"/> A check in the amount of <u>\$1,270.00</u> to cover the above fees is enclosed. b. <input type="checkbox"/> Please charge my Deposit Account No. _____ in the amount of \$_____ to cover the above fees. A duplicate copy of this sheet is enclosed. c. <input checked="" type="checkbox"/> The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. <u>06-1378</u> . A duplicate copy of this sheet is enclosed.					
NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.					
SEND ALL CORRESPONDENCE TO: FRISHAUF, HOLTZ, GOODMAN, LANGER & CHICK 767 Third Avenue - 25th floor New York, N.Y. 10017-2023					
Tel. No. (212) 319-4900 Fax No. (212) 319-5101		 01933 PATENT TRADEMARK OFFICE		 SIGNATURE Herbert Goodman NAME 17,081 REGISTRATION NUMBER	
Date: <u>September 26, 2001</u>					

09/937 802

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Rotor for a high speed permanent magnet motor.

The invention relates to a rotor for a high speed permanent magnet motor. In particular, the invention concerns a motor rotor comprising a plurality of magnetic discs stacked on a central spindle, a clamping device provided to exert an axial clamping force on said magnetic discs to form an axially pre-tensioned disc packet, wherein each of said magnetic discs is provided with at least one electrically insulating layer for electrical separation relative to adjacent discs or to said clamping device.

It is a fact that permanent magnetic materials used in motor rotors are exposed to a high centrifugal stress, and that the tension strength limit of such materials is easily reached at high speed operation. This means that permanent magnetic rotors have to be reinforced to cope with the high centrifugal stresses generated at high speed operation.

A previously known method to reinforce permanent magnet rotors is to provide an outer sleeve enclosing the permanent magnetic material parts of the rotor. Such sleeve may comprise a high-strength metal tube made of on non-magnetic material like titan, cold worked stainless steel etc. or may be formed of a high-strength fiber bandage wound around the permanent magnet parts of the rotor. In both cases the reinforcement is radially pre-tensioned to minimize the tension stress on the magnetic material caused by centrifugal forces during operation of the motor.

In small diameter rotor applications, an outer reinforcement sleeve is undesirable since it adds to the diameter of the rotor. It is undesirable also from the manufacturing cost point of view, because the sleeve not only adds one or more details to the rotor, it also adds a

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number of extra working operations when assembling the rotor.

The above mentioned problems are solved by the invention since a permanent magnet rotor according to the invention does not involve any outer sleeve, but comprises a reinforcement means which does not influence on the diameter of the rotor and does not complicate the assemblage of the rotor.

A preferred embodiment of the invention is below described in detail with reference to the accompanying drawing.

On the drawing:

Fig. 1 shows, partly in section, a side view of a motor having a rotor according to the invention.

Fig. 2 shows a longitudinal section through a rotor according to the invention.

Fig. 3 shows, on a larger scale, a fractional view of the rotor in Fig. 2 illustrating schematically the magnet disc arrangement according to the invention.

The motor illustrated in the drawing figures comprises stator 10 including a cylindrical casing 11, two end walls 12,13, electrical windings 14 and a tubular core 15 surrounding the windings 14, and a rotor 16. The rotor 16 is journaled in two bearings 18,19 supported in the stator end walls 12,13 and comprises a central spindle 20, a plurality of permanent magnet discs 21 provided on each side with a layer 22 of electrically insulating material, and a number of reinforcement discs 23 located between the magnet discs 21. The purpose and functional features of the reinforcement discs 23 will be described in further detail below.

The insulating layers 22 provided on the magnet discs 21 consists suitably of an inorganic material, for instance an oxidized aluminium foil. This type of material has a very high coefficient of elasticity, which means that it has practically no tendency to creep under heavy centrifugal loads. Neither have these materials any tendencies to adopt different coefficients of elasticity at different temperatures. This is advantageous when operating a motor at a very high speed under shifting load conditions.

Since the magnet material used for this purpose is quite brittle and, accordingly, has a low tensile strength, the packet of discs 21 is axially pre-tensioned to assure that no tensile stress in the magnet discs 21 in the axial direction will occur during operation of the motor. This is accomplished by a clamping device comprising two sleeve elements 24, 25 mounted on the spindle 20. One of these sleeve elements 24 is axially supported against a shoulder 26 on the spindle 20, whereas the other sleeve element 25 is backed by a nut 28 engaging a thread 29 on the spindle 20. At the assembly of the rotor 16, the nut 28 is tightened up to the yield stress level of the spindle material in order to obtain the highest possible pre-tension of the magnet disc packet and to assure that no local tension stresses due to bending loads on the rotor 16 will occur in the magnet disc packet.

A permanent magnet motor of the above type is previously described in US Patent No. 5,448,123.

In this type of motor, the magnet discs 21 are also exposed to heavy centrifugal forces during high speed operation, which means that the magnet material may be exposed to a detrimental tensile stress. This, however, is avoided by inserting on both side of each magnet disc 21 a reinforcement disc 23 which due to the axial clamping

action accomplished by the clamping device 24-26,28 frictionally engages each side of the magnet discs 21. This frictional engagement results in a transfer of centrifugal forces from the magnet discs 21 to the reinforcement discs 23 resulting in a tensile stress relief in the magnet discs 21.

In order to fulfil this task, the reinforcement discs 23 are made of a high-strength material such as high-strength metal, ceramic, composite etc. which is very stiff to tensile forces. Accordingly, the coefficient of elasticity of these materials is very high.

In some cases, where the centrifugal forces are not too high and/or the magnet discs 21 are thin, it might be enough to use a reinforcement disc 23 between every second magnetic disc 21 only.

If the magnet discs 21 are thin, it may also be enough to use an electrically insulating layer 22 between every second magnet disc 21 only.

As appears from the drawing figures, the magnetic discs 21 as well as the reinforcement discs 23 are of a flat shape and the centrifugal forces appearing in the magnetic discs 21 are transferred by pure friction to the reinforcement. Using pure flat discs is advantageous in that the discs are easily manufactured from sheet material. Machining the discs into other shapes would be very difficult since the high-strength material in the reinforcement discs 23 is very hard to work. It is conceivable, though, to use conical discs such that the frictional engagement between the magnetic discs 21 and the reinforcement discs 23 is amplified by a radial wedge action between the discs.

In order to accomplish a radial pre-tensioning of the magnetic discs 21 and ensure that absolutely no tensile forces would occur in the magnetic material, the reinforcement discs 23 are heated up before assembling and axially clamping the rotor disc packet. If, however, the thermal coefficient of expansion for the reinforcement discs is sufficiently higher than that of the magnetic discs, it is sufficient to heat the complete rotor assembly before axially clamping the disc packet. Heating of the complete rotor assembly would of course simplify the assembly process. When cooling off, the shrinkage of the reinforcement discs 23 accomplishes, via the frictional engagement, a radially inwardly directed pre-tension of the magnet discs 21.

Claims.

1. Rotor for a high speed permanent magnet motor comprising a central spindle (20), a plurality of magnet discs (21) stacked on said spindle (20), said spindle (20) having a clamping device (24-26,28) for exerting an axial clamping force on said magnet discs (21), thereby forming an axially pre-tensioned disc packet,
c h a r a c t e r i z e d in that between at least every second magnet disc (21) and /or between one magnet disc (21) and said clamping device (24-26,28) there is located a reinforcement disc (23) of a non-magnetic high-strength material,
each reinforcement disc (23) being clamped by said axial clamping force between said at least every second magnet disc (21) or between one magnet disc (21) and said clamping device (24,26,28), thereby accomplishing a frictional engagement between said reinforcement discs (23) and said magnet discs (21) for transferring centrifugal forces from said magnet discs (21) to said reinforcement discs (23), thereby relieving said magnet discs (21) of tensile stress.
2. Rotor according to claim 1, wherein a reinforcement disc (23) is located between every two adjacent magnet discs (21).
3. Rotor according to claim 1 or 2, wherein each one of said magnet discs (21) comprises at least one electrically insulating layer (22).
4. Rotor according to claim 1, wherein said reinforcement discs (23) are flat in shape.
5. Rotor according to claim 1, wherein said reinforcement discs (23) consists of a high-strength metal.

6. Rotor according to claim 1, wherein said reinforcement discs (23) consists of a ceramic material.

7. Rotor according to claim 1, wherein said magnet discs (21) are radially pre-tensioned by a pre-assembly heat treatment of said reinforcement discs (23).

8. Rotor according to claim 7, wherein the thermal coefficient of expansion for the material of the reinforcement discs (23) is higher than that of the material of the magnet discs (21), and said heat treatment comprises a heating-up of the complete rotor assembly before applying said axial clamping force.

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FIG 1

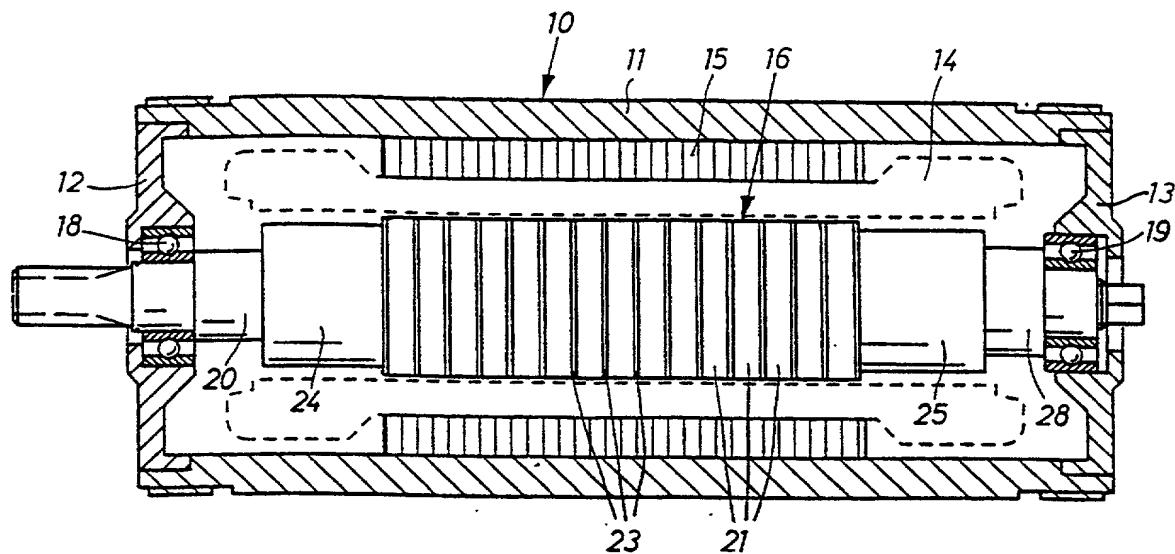


FIG 2

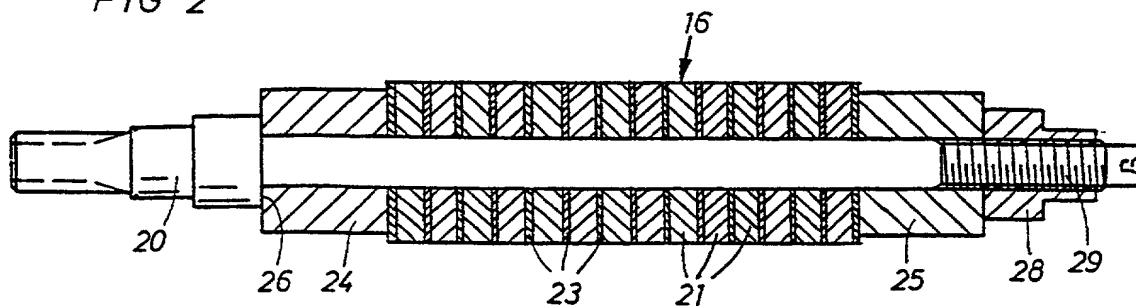
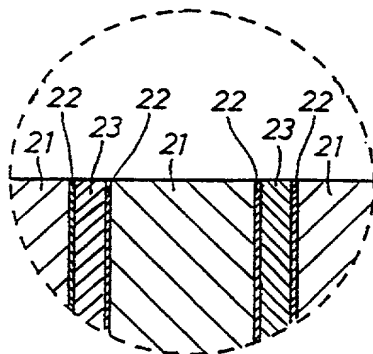


FIG 3



APPLICATION FOR UNITED STATES LETTERS PATENT

POST-FILED

PCT Declaration and Power of Attorney (35 U.S.C. 371(c)(4))

PCT Application - United States Designated Office

As a below named inventor, I declare that:

My residence, post office address and citizenship are as stated below next to my name; I believe that I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

ROTOR FOR A HIGH SPEED PERMANENT MAGNET MOTOR

described and claimed in serial number 09/937,802 deposited 26 September 2001 which is the national phase application of international application number PCT/SE00/00591 filed 27 March 2000

I have reviewed and understand the contents of said specification, including claims.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR §1.56.

I claim priority benefits under 35 USC §119 of: (i) any foreign application(s) for patent or inventor's certificate listed below; or (ii) any United States provisional application(s) listed below; and have also identified below any foreign application(s) for patent or inventor's certificate, or PCT international application having a filing date before that of the application(s) on which priority is claimed.

COUNTRY	APPLICATION NUMBER	DATE (day, month, year)	PRIORITY CLAIMED
Sweden	9901107-4	26 MAR 1999	yes <input checked="" type="checkbox"/> no <input type="checkbox"/>
			yes <input type="checkbox"/> no <input type="checkbox"/>

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

I appoint the following attorneys to prosecute this application and to transact all business in the U.S. Patent & Trademark Office connected therewith: Stephen H. Frishauf, Reg. No. 16,233; Leonard Holtz, Reg. No. 22,974; Herbert Goodman, Reg. No. 17,081; Thomas Langer, Reg. No. 27,264; Marshall J. Chick, Reg. No. 26,853; Walter J. Baum, Reg. No. 20,641; Richard S. Barth, Reg. No. 28,180; Douglas Holtz, Reg. No. 33,902; and Robert P. Michal, Reg. No. 35,614.

CORRESPONDENCE AND CALLS TO:

FRISHAUF, HOLTZ, GOODMAN, LANGER & CHICK, P.C.
767 Third Avenue - 25th Floor Tel.: (212) 319-4900
New York, New York 10017-2023 Fax.: (212) 319-5101

INVENTOR: SIGNATURE

DATE

RESIDENCE AND POST OFFICE ADDRESS

Sign: <i>Thord Agne Gustaf Nilsson</i>	Date: <i>Oct 6, 2001</i>	Residence: (City & Country)
Type: <i>Thord Agne Gustaf NILSON</i>	Citizen of: <i>Sweden</i>	Post Office Address: <i>of 2B, Långsjövägen S-135 54 Tyresö, Sweden SEX</i>
Sign:	Date:	Residence: (City & Country)
Type:	Citizen of:	Post Office Address:
Sign:	Date:	Residence: (City & Country)
Type:	Citizen of:	Post Office Address: